

**Student questions: Missy Eppes colloquium on “Cracking Up: Gaining new insight into mechanical weathering through the lens of fracture mechanics”**

9/19/18

In using the assumption that critical crack length is equal to the grain diameter, are there additional considerations taken into account for conditions that may exist outside this model?

**Yes, we know that other types of through-going cracks exist, but as you move into the interior of a rock, the stresses will change, making the modeling much more complex. We decided to start with the simplest system.**

For the experiment that measured the acoustic emissions of the boulders, have you considered extending this experiment to include a greater variety of rock compositions and/or environmental conditions?

**Yes, in fact, I am leaving in 2 months for Antarctica where we will instrument 4 boulders at the same time that each have slightly different characteristics, like different grain size! We will see!**

If all else is held constant, how much does absolute temperature (as opposed to diurnal difference) factor into the rate of microfracturing?

**The thermal stresses in a boulder arise from the difference; so others have shown that you can change the absolute magnitude of temperature and that doesn't really affect the stress like the difference does.**

How much does scale affect fractures? I imagine that heat capacity plays a role in the temperature variation of rocks and that bigger rocks can sustain higher thermal gradients within them.

**Yes, but I have seen that even large boulders have N-S cracks; I suspect that the ‘bumpiness’ of the boulder results in a local thermal stress that gets the crack going, despite the boulder’s size.**

Do you expect that rocks with a more directed fabric than the rocks you tested (say a gneiss for example) would exhibit any change in the preferred direction of cracking in order to crack closer to parallel to the fabric rather than the N/NE trend you have seen so far?

**Yes, when there is a fabric, the cracks do follow that.**

You discussed thermal stresses at the grain boundary level. Are there thermal stress effects at the molecular level?

**These are molecular stresses at grain boundaries.**

What types of weathering are there other than mechanical? How can you tell which type of weathering occurred?

**Chemical weathering results in a change in composition.**

What does it mean when a rock type is metamorphized?

**Changed by heat or pressure.**

Are there fewer cracks in rocks that are in environments that don't experience the thermal stress from the sun (e.g. in caves)?

**A question that I have had for a long time! I have a trip scheduled to look at Cave Cracks in February!!**

Why is there no preferred directionality in the cracks in the mars rocks?

**There was, it just was not as strong; I think partially because of the much larger Obliquity of Mars over Earth.**

For the fractures seen in arid climates there were some that were oriented E-W, are these somehow related to those that are N-S?

**Stresses that arise at different times of day or year.**

When you went to those outcrops, I'm not sure if you said they were in Virginia but would you be able to perform the same research that you been handicap? Such as not being able to walk long distances. I am a Disabled Student but also a geology major and I want to do Advanced research in the field.

**I think of this often with my students. For many of the outcrops in that study, it would have been extremely difficult to access them as they were along rough trails many miles out. However, the laboratory analyses that we completed would be accessible. Also, it was really important to get measurements from non-natural outcrops that had been exposed by roadcuts, so those would have been accessible.**

Can this understanding be applied to other ice and snow given their crystalline structure?

**Yes! Folks interested in ice physics also study subcritical cracking.**

Could the orientations of the cracks be dependent on the path of the sun during the season that they broke from their parent bodies?

**Yes, hence the E-W cracks sometimes, I think!**

Is there a way to determine what percentage of a fracture's magnitude and orientation is due to one particular factor, like the direction and intensity of sunlight?

**Very good question. Stress intensity is additive, so all stresses that are acting on a rock at the same time contribute to the cracking. I think it will be very difficult to tease those apart from each other.**

Are there any differences for the cracks at the bottom of a rock from the cracks at other sides?

**We have noted from our Acoustic emissions and observations in the field, that most of the cracks form on the tops of boulders – more so than the sides.**